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Mounting Device for Semiconductor Devices and the Like

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7 Claims

This invention relates to a device which is useful for mounting semiconductor devices or the like on printed circuit boards, radio or television chassis, or other similar apparatus. In particular this invention relates to a mounting device which acts as a heat sink to prevent thermal damage to semiconductor devices or the like when their leads are soldered to such apparatus.

Many semiconductor devices are extremely temperature sensitive in the sense that their crystals have maximum operating temperature ratings, which, if exceeded even for only a short time, would result in permanent thermal damage. For example, transistors or diodes made of germanium generally have maximum temperature limits in the range of 70-100°C. while silicon transistors generally have temperature limits of 150-200°C.

Ambient temperatures of such magnitudes obviously are not generally encountered in locations where electronic equipment utilizing transistors is to be found. In some instances, however, electronic equipment is required to operate under such elevated ambient temperatures, in which case artificial cooling must be used to protect circuit components such as transistors. However, when the leads of semiconductor devices are to be soldered to printed circuit boards, radio and TV chassis, wire conductors and similar apparatus, it is very easy for the maximum temperature rating of vital parts of the transistor to be exceeded as a result of heat conduction from the soldering iron or dip-solder bath along the lead-in conductors to the semiconductor crystal and from the heated surroundings in general.

In order to prevent thermal damage to the semiconductor device during soldering operations, various methods have been used. Manufacturers have made the lead-in conductors long and advise full utilization of the complete length of the leads. Needle-nose pliers may be used to grip the leads when soldering and thereby act as a heat sink. Both these solutions have draw-backs however. Long leads are cumbersome, and take up space, which is quite undesirable in equipment for which transistors have been selected because of their small size. The heat sink method employing needle-nose pliers obviously is not well adapted to mass production techniques.

Accordingly it is an object of my invention to provide improved means for preventing thermal damage to semiconductor devices and the like.

It is another object of my invention to provide such improved means which are easy to manufacture, economical to produce, and which facilitate mass production soldering techniques.

In brief, my invention, in one embodiment, comprises a mounting device adapted to be located between the bottom of the capsulating can of a semiconductor device and the apparatus to a part of which the leads of the semiconductor device are to be soldered. Such a mounting device comprises a pad through which the leads extend, and which has sufficient thermal capacity to prevent thermal damage to the semiconductor device during the short time when the leads are soldered to a part of the apparatus, which may be, for example, a printed circuit board.

The thermal capacity of a solid material, as herein used, is to be construed as the ability of the material to absorb heat. Thus materials having high specific heats and/or high latent heats of fusion have high thermal capacities. In other words, a specified amount of a material A which absorbs 500 units of heat and changes its temperature from 0°C to 50°C has a higher thermal capacity, i.e. it absorbs more heat, than the same amount of a solid material B which only absorbs 300 units of heat for the same temperature change. Similarly a specified amount of a solid material A which requires 500 units of heat to change its temperature from 0°C to 100°C and 400 units of heat to liquify it at that temperature has a higher total thermal capacity than the same amount of a solid material B which requires 600 units of heat to raise its temperature from 0°C to its melting point and 100 units to liquify it at that temperature. It is clear, then, that what is meant by a pad having a thermal capacity sufficient to prevent thermal damage to a semiconductor device, the leads of which extend through the pad, is simply a pad which absorbs a sufficient amount of heat from the leads and surroundings during the time that the leads are being soldered to some apparatus, that the resultant temperature increase in the vicinity of the semiconductor crystal is kept within allowable limits.

Further objects and advantages of my invention will become evident from the ensuing disclosure taken in conjunction with the drawings in which,

Fig. 1 shows a top view of a mounting device embodying my invention,

Fig. 2 depicts a front view of the same device, and

Fig. 3 shows a front view, partly in section, of a transistor, a printed circuit board, and a mounting device, constructed according to my invention, sandwiched therebetween.

In Fig. 3, I have shown a capsulated transistor 1 to which are suitably fixed leads 2. Leads 2 are soldered at 3 to conductors 4 mounted on a printed circuit board 5. In accordance with one embodiment of my invention, a mounting device or pad 7 is sandwiched between printed circuit board 5 and the bottom 6 of the transistor 1.

In Figures 1 and 2, mounting device 7 comprises a paper or cardboard base 9 on which is deposited a layer of heat absorbing material 8. Holes 10, passing through the base 9 and the heat absorbing layer 8, are provided to receive leads 2.

As previously mentioned, when a semiconductor device such as a transistor is soldered to a printed circuit board or similar device, as shown in Fig. 3, heat is conducted along leads 2 and may thermally damage the semiconductor crystals to which leads 2 are fixed. Thermal damage is obviated completely, however, by pad 7 which is composed of a material having a thermal capacity sufficient to absorb enough heat from leads 2 and the surroundings to prevent the maximum temperature rating of transistor 1 from being exceeded. In one particular application a pad of paraffin wax $\frac{1}{32}$ inches in thickness was found to be very suitable. The amount of heat that may be absorbed by pad 7 is dependent on the material of

which it is composed, its thickness and its volume. All of the foregoing may be varied in accordance with the ambient temperature where the semiconductor device is to be soldered, and the maximum temperature not to be exceeded.

It will be understood that heat absorption by pad 7 may take two forms. Pad 7 may absorb heat and increase temperature only, while not liquifying. Such a pad would be composed of a material having a high specific heat. On the other hand pad 7 may actually liquify, in which case not only would heat be absorbed in raising the temperature of pad 7 from ambient to its melting point, but also the latent heat of fusion would be absorbed. With two qualifications, it is immaterial which process takes place as long as the total amount of heat absorbed, i.e. the thermal capacity of pad 7, is sufficient to prevent the maximum operating temperature rating of the semiconductor device from being exceeded. The two qualifications are, that (1) if the latter process is used the melting point of the material comprising pad 7 should be less than the maximum temperature rating of the semiconductor device, and (2) the material should not adversely affect soldering since some of the liquid material may find its way to the point where soldering is taking place. Paraffin wax, which has both a high specific heat and a high heat of fusion, has been found to be a generally suitable material.

As shown in Figs. 1 and 2, manufacture of pad 7 may be facilitated by depositing suitable heat absorbing material 8 on a backing sheet 9 such as paper or cardboard. Pad 7 may then be stamped from the sheet and holes 10 formed therein during the same operation.

While I have particularly described my invention with respect to semiconductor devices, it will be obvious that it is equally applicable in the soldering of any other type of electrical component, such as, a resistor or capacitor which has maximum temperature limits not to be exceeded.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. The combination of an electrical component having one or more leads affixed thereto and a mounting device adapted to be located between said electrical component and apparatus to a part of which one or more of said leads of said electrical component are to be soldered, said mounting device comprising a pad through which said one or more of said leads extend, said pad having a thermal capacity sufficient to prevent thermal damage to said electrical component when said one or more of said leads are soldered to a part of said apparatus.

2. The combination of a semiconductor device having one or more leads affixed thereto and a mounting device adapted to be located between said semiconductor device and apparatus to a part of which one or more of said leads of said semiconductor device are to be soldered, said mounting device comprising a pad through which said one or more of said leads extend, said pad having a thermal capacity sufficient to prevent thermal damage to said semiconductor device when said one or more of said leads are soldered to a part of said apparatus.

3. The combination of a transistor or the like having leads affixed thereto and a mounting device adapted to be located between said transistor and apparatus to a part of which one or more of said leads of said transistor are to be soldered, said mounting device comprising a pad through which said one or more of said leads extend, said pad having a thermal capacity sufficient to prevent thermal damage to said transistor when said one or more of said leads are soldered to a part of said apparatus.

4. The combination of a semiconductor device having one or more leads affixed thereto and a mounting device adapted to be located between said semiconductor device and apparatus to a part of which one or more of said leads of said semiconductor device are to be soldered, said mounting device comprising a pad consisting essentially of paraffin wax, said pad being positioned in heat transfer relationship with said one or more of said leads, and having a thermal capacity sufficient to prevent thermal damage to said semiconductor device when said one or more of said leads are soldered to a part of said apparatus.

5. The combination of a semiconductor device having one or more leads affixed thereto and a mounting device adapted to be located between said semiconductor device and apparatus to a part of which one or more of said leads of said semiconductor device are to be soldered, said mounting device comprising a pad having a specific heat and a heat of fusion comparable to that of paraffin wax, said pad being positioned in heat transfer relationship with said one or more of said leads, and having a thermal capacity sufficient to prevent thermal damage to said semiconductor device when said one or more of said leads are soldered to a part of said apparatus.

6. The combination of a semiconductor device having one or more leads affixed thereto and a mounting device adapted to be located between said semiconductor device and a printed circuit board or chassis to a part of which one or more of said leads of said semiconductor device are to be soldered, said mounting device comprising a pad through which said one or more of said leads extend, said pad having a thermal capacity sufficient to prevent thermal damage to said semiconductor device when said one or more of said leads are soldered to a part of said printed circuit board or chassis.

7. The combination according to claims 4, 5 or 6 wherein said semiconductor device is a transistor.

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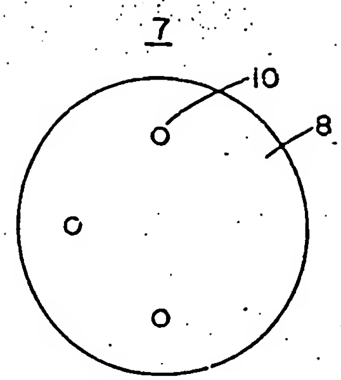

FIG. 1

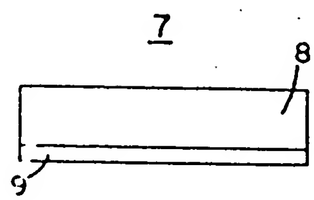

FIG. 2

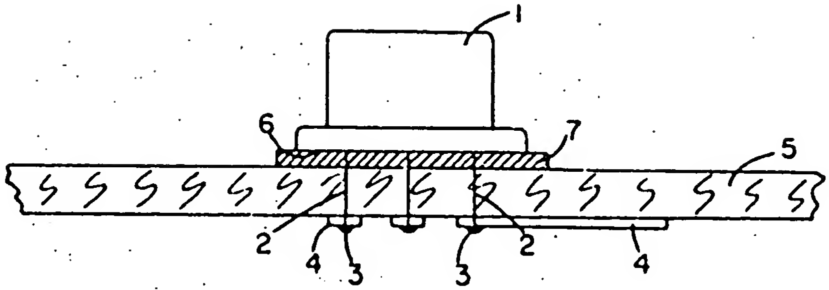

FIG. 3

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